

**Engineering Evaluation
Ping Yuen North Apartments
Application No. 23681
Plant No. 20914**

838 Pacific Street, San Francisco, CA 94133

BACKGROUND

Ping Yuen North Apartments has applied for an Authority to Construct (AC) and/or a Permit to Operate (PO) for the following equipment:

- S-1 Cogeneration Units: Natural Gas engine
General Motors, Model: Tecoge CM-60E, Model Year: 2008
85 bhp, 0.792 MMBtu/hr**
- A-1 Non-Selective Catalytic Converter (Nett Technologies 3-way Catalyst)
Sud-Chemie, EnviCat 7319, PRCPTPROD, 116 scfm**

The natural gas powered co-generation unit (S-1) is equipped with the best available control technology (BACT) for minimizing emissions of airborne criteria pollutants and harmful air toxins due to fuel combustion. The criteria pollutants are nitrogen oxides (NO_x), carbon monoxide (CO), precursor organic compounds (POC) from unburned diesel fuel, sulfur dioxide (SO₂) and particulate matter (PM₁₀). POC is also denoted as NMHC (non-methane hydrocarbon). All of these pollutants are described on the District's website at www.baaqmd.gov.

The natural gas (NG) powered non-emergency cogeneration unit (S-1) will provide 60 KW of electricity that is needed by the Facility, which allows the site to purchase less electricity from the local utility. The NG fueled engine is equipped with a Non-Selective Catalytic Reduction (NSCR) unit (A-1) to limit NO_x emissions.

EMISSIONS CALCULATIONS

Annual Emissions & Daily Emissions

The emission factors used to estimate criteria pollutant emissions from the NG engine co-generation set described above are based on engine manufacturer abated and unabated emissions data. Total Hydrocarbon emission rates were assumed to be equal to Precursor Organic Compound (POC) emission rates.

Except for NO_x, the Emissions from the engine is from the manufacturer's specification. The NO_x emissions factor is assumed to be the maximum level allowed by Regulation 9-8-301.1.

The applicant has specified that S-1 will be operated for 24 hours a day, 7 days a week, 52 weeks a year, for a total of 8,736 hours per year. The emission factors and annual emissions from these engines are summarized in Table 1.

Table 1 Emission Factors and Estimated Annual Emissions of Criteria Pollutants

Pollutant	Unabated Emission Factor (g/BHP-hr)	Abated Efficiency (%)	Abated Emission Factor (g/BHP-hr)	Abated Emission (lb/day)	Abated Emission (lb/yr)	Abated Emission (TPY)
NO _x	13.40	97.4%	0.350	1.3	492.5	0.246
POC	3.00	94.0%	0.180	0.8	295.5	0.148
CO	16.90	96.4%	0.600	2.7	984.9	0.492

TOXIC RISK SCREENING ANALYSIS

The emission factors used to estimate Hazardous Air Pollutants (HAPs) emissions from the engine described above are from: AP-42 for natural gas fired 4-cycle rich burn engine Table 3.2-3, or the California Air Toxics Emission Factor Database (maintained by the California Air Resources Board) for natural gas fired 4-cycle rich burn engines with less than 650 hp. The engine being permitted has a maximum firing rate of 0.792 MM Btu/hr and a maximum rating of 85 bhp. The CATEF Emission Factors maintained by the ARB were used to estimate emissions for all compounds that have AP-42 emission factors and CATEF emission factors.

The HAP emission estimates are based on uncontrolled emission factors for natural gas engines and an assumed abatement efficiency of 50% removal of organic HAP compounds. The abatement efficiency is based on the fact that the engine is being permitted with a Catalytic Converter and an air fuel ratio controller.

As shown in Table 2 and Table 3 below, the chronic emission of Benzene exceeds toxic trigger level. Hence, toxic risk screening analysis is required.

Table 2
HAP EMISSIONS ESTIMATES BASED ON AP-42 TABLE 3.2-3 (FOR COMPOUNDS WITH NO CATEF E.F.)

Compound	E.F.	Unit	Assumed Abatement Efficiency %	Abated Emissions (lb/hr)	Acute Trigger Level (lb/hr)	HRSA Triggered? (Y/N)	Abated Emissions (lb/yr)	Chronic Trigger Level (lb/yr)	HRSA Triggered? (Y/N)
1,1,2,2-Tetrachloroethane	2.53E-05	lb/MMBtu	50	1.00E-05	None	NO	8.77E-02	1.90E+00	NO
1,1,2-Trichloroethane	< 1.53E-05	lb/MMBtu	50	6.06E-06	None	NO	5.30E-02	6.60E+00	NO
1,1-Dichloroethane	< 1.13E-05	lb/MMBtu	50	4.47E-06	None	NO	3.92E-02	6.60E+01	NO
1,2-Dichloroethane	< 1.13E-05	lb/MMBtu	50	4.47E-06	None	NO	3.92E-02	None	NO
1,2-Dichloropropane	< 1.30E-05	lb/MMBtu	50	5.14E-06	None	NO	4.51E-02	None	NO
1,3-Butadiene	6.63E-04	lb/MMBtu	50	CATEF	None	NO	CATEF	1.10E+00	NO
1,3-Dichloropropene	< 1.27E-05	lb/MMBtu	50	5.03E-06	None	NO	4.40E-02	None	NO
Acetaldehyde	2.79E-03	lb/MMBtu	50	CATEF	1.00E+00	NO	CATEF	3.80E+01	NO
Acrolein	2.63E-03	lb/MMBtu	50	CATEF	5.5E-03	NO	CATEF	1.40E+01	NO
Benzene	1.58E-03	lb/MMBtu	50	CATEF	2.9E+00	NO	CATEF	3.80E+00	NO
Butyr/isobutyraldehyde	4.86E-05	lb/MMBtu	50	1.92E-05	None	NO	1.68E-01	None	NO
Carbon Tetrachloride	< 1.77E-05	lb/MMBtu	50	7.00E-06	4.2E+00	NO	6.14E-02	2.50E+00	NO
Chlorobenzene	< 1.29E-05	lb/MMBtu	50	5.11E-06	None	NO	4.47E-02	3.90E+04	NO
Chloroform	< 1.37E-05	lb/MMBtu	50	5.42E-06	3.3E-01	NO	4.75E-02	2.00E+01	NO
Ethane	7.04E-02	lb/MMBtu	50	2.79E-02	None	NO	2.44E+02	None	NO
Ethylbenzene	< 2.48E-05	lb/MMBtu	50	CATEF	None	NO	CATEF	4.30E+01	NO
Ethylene Dibromide	< 2.13E-05	lb/MMBtu	50	8.43E-06	None	NO	7.38E-02	1.50E+00	NO
Formaldehyde	2.05E-02	lb/MMBtu	50	CATEF	1.2E-01	NO	CATEF	1.80E+01	NO
Methanol	3.06E-03	lb/MMBtu	50	1.21E-03	6.2E+01	NO	1.06E+01	1.50E+05	NO
Methylene Chloride	4.12E-05	lb/MMBtu	50	1.63E-05	3.1E+01	NO	1.43E-01	1.10E+02	NO
Naphthalene	< 9.71E-05	lb/MMBtu	50	CATEF	None	NO	CATEF	3.20E+00	NO
PAH	1.41E-04	lb/MMBtu	50	CATEF	None	NO	CATEF	None	NO
Styrene	< 1.19E-05	lb/MMBtu	50	4.71E-06	4.6E+01	NO	4.13E-02	3.50E+04	NO
Toluene	5.58E-04	lb/MMBtu	50	2.21E-04	8.2E+01	NO	1.93E+00	1.20E+04	NO
Vinyl Chloride	< 7.18E-06	lb/MMBtu	50	2.84E-06	4.0E+02	NO	2.49E-02	1.40E+00	NO
Xylene	1.95E-04	lb/MMBtu	50	7.72E-05	4.9E+01	NO	6.76E-01	2.70E+04	NO

Table 3
HAP EMISSION ESTIMATES BASED ON CATEF EMISSION FACTORS

	Assumed	Acute	Chronic
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SUBSTANCE	E.F. MEAN	UNIT	Abatement Efficiency %	Abated Emissions (lb/hr)	Trigger Level (lb/hr)	HRSA Triggered? (Y/N)	Abated Emissions (lb/yr)	Trigger Level (lb/yr)	HRSA Triggered? (Y/N)
1,3-Butadiene	1.04E-01	lbs/MMcf	50	4.07E-05	None	NO	3.56E-01	6.30E-01	NO
Acenaphthene	1.94E-03	lbs/MMcf	50	7.59E-07	None	NO	6.64E-03	None	NO
Acenaphthylene	1.45E-02	lbs/MMcf	50	5.67E-06	None	NO	4.97E-02	None	NO
Acetaldehyde	8.83E-01	lbs/MMcf	50	3.45E-04	None	NO	3.02E+00	3.80E+01	NO
Acrolein	5.47E-01	lbs/MMcf	50	2.14E-04	5.50E-03	NO	1.87E+00	1.40E+01	NO
Anthracene	1.84E-03	lbs/MMcf	50	7.19E-07	None	NO	6.30E-03	None	NO
Benzene	7.39E-02	lbs/MMcf	50	2.89E-05	2.90E+00	NO	2.53E-01	3.80E+00	NO
Benzo(a)anthracene	2.94E-04	lbs/MMcf	50	1.15E-07	None	NO	1.01E-03	None	NO
Benzo(a)pyrene	1.15E-04	lbs/MMcf	50	4.50E-08	None	NO	3.94E-04	None	NO
Benzo(b)fluoranthene	2.37E-04	lbs/MMcf	50	9.27E-08	None	NO	8.12E-04	None	NO
Benzo(g,h,i)perylene	1.95E-04	lbs/MMcf	50	7.62E-08	None	NO	6.68E-04	None	NO
Benzo(k)fluoranthene	1.03E-04	lbs/MMcf	50	4.03E-08	None	NO	3.53E-04	None	NO
Chrysene	3.10E-04	lbs/MMcf	50	1.21E-07	None	NO	1.06E-03	None	NO
Dibenz(a,h)anthracene	1.25E-05	lbs/MMcf	50	4.89E-09	None	NO	4.28E-05	None	NO
Ethylbenzene	1.16E-02	lbs/MMcf	50	4.54E-06	None	NO	3.97E-02	4.30E+01	NO
Fluoranthene	9.95E-04	lbs/MMcf	50	3.89E-07	None	NO	3.41E-03	None	NO
Fluorene	6.91E-03	lbs/MMcf	50	2.70E-06	None	NO	2.37E-02	None	NO
Formaldehyde	4.99E-02	lbs/MMcf	50	1.95E-05	2.1E-01	NO	1.71E-01	1.80E+01	NO
Indeno(1,2,3-cd)pyrene	1.69E-04	lbs/MMcf	50	6.61E-08	None	NO	5.79E-04	None	NO
Naphthalene	7.65E-02	lbs/MMcf	50	2.99E-05	None	NO	2.62E-01	3.20E+00	NO
Phenanthrene	7.07E-03	lbs/MMcf	50	2.76E-06	None	NO	2.42E-02	None	NO
Propylene	1.60E+01	lbs/MMcf	50	6.26E-03	None	NO	5.48E+01	1.20E+05	NO
Pyrene	1.79E-03	lbs/MMcf	50	7.00E-07	None	NO	6.13E-03	None	NO
Toluene	1.07E+00	lbs/MMcf	50	4.18E-04	8.2E+01	NO	3.66E+00	1.20E+04	NO
Xylene (m,p)	4.41E-01	lbs/MMcf	50	1.72E-04	4.9E+01	NO	4.90E+01	2.70E+04	NO
Xylene (o)	2.17E-01	lbs/MMcf	50	8.48E-05	4.9E+01	NO	4.90E+01	2.70E+04	NO
Xylene (Total)	6.02E-02	lbs/MMcf	50	2.35E-05	4.9E+01	NO	4.90E+01	2.70E+04	NO
PAH Equivalents as Benzo(a)pyrene								1.10E-02	NO

A Health Risk Screening Analysis (HRSA) was requested originally because the estimated Benzene emission seemed to trigger HRSA; however, the Toxic Analysis Section of the District determined this application does not trigger a HRSA, because the risk screen triggers for emitted toxic air contaminants (TAC) are not exceeded. Emission factors for California Air Toxic Emissions Factors (CATEF) TAC were updated based on the Toxic Evaluation Analysis Section's recommendation.

PLANT CUMULATIVE EMISSIONS

Table 4 summarizes the cumulative increase in criteria pollutant emissions that will result from the operation of S-1.

Table 4 Plant Cumulative Increase (TPY)

Pollutant	Existing	New	Total
NOx	0.000	0.246	0.246
POC	0.000	0.148	0.148
CO	0.000	0.492	0.492
PM10	0.000	0	0

BEST AVAILABLE CONTROL TECHNOLOGY (BACT)

In accordance with Regulation 2-2-301, BACT is triggered for any new or modified source with the potential to emit 10 pounds or more per highest day of POC, NPOC, NO_x, CO, SO₂ or PM₁₀.

Based on the emission calculations above, BACT is not triggered for any pollutant since the maximum daily emission of the each pollutant does not exceed 10 lb/day. Since the low emissions level is dependent on usage of the abatement device, a condition has been added requiring its use.

OFFSETS

Per Regulation 2-2-302, offsets must be provided for any new or modified source at a facility that emits more than 10 tons/yr of POC or NO_x. Based on the emission calculations above, offsets are not required for this application.

STATEMENT OF COMPLIANCE

The owner/operator of S-1 Natural Gas Fired Cogeneration Plant abated by A-1 (Non-Selective Catalytic Converter shall comply with Regulation 6 (Particulate Matter and Visible Emissions Standards) and Regulation 9-1-301 (Inorganic Gaseous Pollutants: Sulfur Dioxide for Limitations on Ground Level Concentrations). The owner/operator is expected to comply with Regulation 6 since the unit is fueled with natural gas. Thus for any period aggregating more than three minutes in any hour, there should be no visible emission as dark or darker than No.1 on the Ringlemann Chart (Regulation 6-301) and no visible emission to exceed 20% opacity (Regulation 6-302). Sulfur oxides are also very low since natural gas is being used. Sulfur compounds are removed from natural gas at processing plants.

S-1 is also subject to Regulation 9 Rule 8 (Nitrogen Oxides and Carbon Monoxide from Stationary Internal Combustion Engines) requirements.

Until January 1, 2012, the engine is exempt from the emission limits of Regulation 9-8-301 as per Regulation 9-8-110.1 since the engine is rated at less than 250 HP.

Starting January 1, 2012, the engine will be subject to Regulation 9-8-110.1. Regulation 9-8-110.1 requires the average NO_x emissions to no more than 25 ppmv @ 15% O₂ Dry Basis, and the CO emissions to be no more than 2000 ppmv @ 15% O₂ Dry Basis. Based on the emission factors provided in the manufacturer's specification, S-1 will comply with Regulation 9-8-110 requirements.

Starting January 1, 2012, S-1 is required to conduct a quarterly source test per Regulation 9-8-503 Quarterly Demonstration of Compliance:

The owner/operator shall use a portable analyzer to take NO_x and CO emission readings to verify compliance with the applicable emission limits in Sections 9-8-301.1 at least once during each calendar quarter in which a source test is not performed. All emission readings shall be taken with the engine operating either at conditions representative of normal operations or conditions specified in the permit-to-operate. The analyzer shall be calibrated, maintained, and operated in accordance with the manufacturer's specifications and recommendations.

S-1 is also subject to Regulation 9-8-502 Recordkeeping:

The owner or operator of S-1 shall keep records of the number of hours the engine is fired and fuel usage on a monthly basis, and also the owner or operator shall keep records of the compliance demonstration required by Regulation 9-8-503. All record shall be kept for a minimum of 24 months from the date of creation and made available to the District staff upon request.

The project is considered to be ministerial under the CEQA regulation 2-1-311 and therefore is not subject to CEQA review. The engineering review for this project requires only the application of standard permit conditions and standard emissions factors and therefore is not discretionary as defined by CEQA. (Permit Handbook Chapter 2.3)

Public Notice is triggered because the equipment is within 1000 ft of K-12 school.

A public notice will be prepared and mail to students and their parents and all business within 1000 ft of the following school(s):

Jean Parker Elementary School
840 Broadway Street
San Francisco, CA 94133

Gordon Lau Elementary School
950 Clay Street
San Francisco, CA 94108

PSD, NSPS, and NESHAPS do not apply.

PERMIT CONDITIONS

COND# XXXXX

Ping Yuen North Apartments (October 2011)
Application#23681
Plant#20914
A modification from Condition#20648

S-1 Cogeneration Units: Natural Gas engine
General Motors, Model: Tecoge CM-60E, Model Year: 2008
85 bhp, 0.792 MMBtu/hr

1. The owner/operator shall fire S-1 exclusively with natural gas.
(Basis: cumulative increase)
2. The owner/operator shall not operate the engine is abated by A-1.
(Basis: cumulative increase, BACT)
3. The owner/operator shall not operate either engine such that emissions exceed any of the following /limits:
 - a. NOx: 25 ppmv @ 15% O₂ Dry Basis.
 - b. CO: 72 ppmv @15% O₂ Dry Basis
(Basis: cumulative increase, Reg9-8-110.1)
4. To demonstrate compliance with part 3, the owner/operator shall use a portable analyzer to take NOx and CO emission readings to verify compliance with the applicable emission limits in Part 3 at least once during each calendar quarter in which a source test is not performed. All emission readings shall be taken with the engine operating either at conditions representative of normal operations or conditions specified in the permit-to-operate. The analyzer shall be calibrated, maintained, and operated in accordance with the manufacturer's specifications and recommendations.
(Basis: Regulation 9-8-503)
5. Records: The owner/operator shall maintain the following monthly records in a District-approved log for at least 36 months from the date of entry. Log entries shall be retained on-site, either at a central location or at the engine's location, and made immediately available to the District staff upon request.
 - a. NOx and CO concentration measurements taken per Regulation 9-8-503
 - b. Any source tests results
 - c. Fuel usage
 - d. Operation hours
(Basis: Regulation 9-8-502, Record Keeping)

RECOMMENDATION

Issue an Authority to Construct to **Ping Yuen North Apartments** for:

**S-1 Cogeneration Units: Natural Gas engine
General Motors, Model: Tecoge CM-60E, Model Year: 2008
85 bhp, 0.792 MMBtu/hr**

Jin Qiu
Air Quality Engineering Intern

Date